that a record can be located rapidly by means of a computer and a complete microfilm of the original record provided almost simultaneously on a suitable screen. Attention was also drawn to devices such as mini-cassettes which could hold vast amounts of information in documentation centres.

Asparagine and Tumours

from our Medical Biochemistry Correspondent

ASPARAGINE is the amide of aspartic acid. It can be formed from ammonia, aspartic acid and adenosine triphosphate (ATP), but some enzymes use the amide of glutamic acid, glutamine, as a source of ammonia. The importance of asparagine to some tumour cells was discovered almost accidentally. The growth of some tumours was inhibited by guinea-pig serum but not by serum from other animals. In 1961 J. D. Broome (*Nature*, **191**, 1114; 1968) showed that the inhibitory effect of guinea-pig serum on lymphomas was caused by the high concentration of the enzyme asparaginase in the serum. Asparaginase removes the amide group as ammonia, forming aspartic acid. It was assumed that tumours which were sensitive to asparaginase required a supply of asparagine, and treatment with asparaginase removed this supply.

Horowitz and co-workers have now shown that it is possible to predict accurately which mouse leukaemias will respond to treatment with asparaginase by measuring the asparagine synthetase activity of the tumour cells (*Science*, **160**, 533; 1968). The tissues were homogenized, and the supernatant solutions were incubated in buffer with ATP, magnesium chloride, glutamine and aspartic acid-4-^{14}C. After incubation the components of the supernatant solution were separated by electrophoresis, and the enzyme activity calculated from the amount of ^{14}C-asparagine formed. The enzyme activities were expressed as nanomoles of asparagine per mg protein per h. Most normal mouse tissues had relatively low activities, and the highest activities were in brain (5·2) and testes (13·6). Seven different mouse leukaemias which were known to be sensitive to asparaginase all had very low or unmeasurable asparagine synthetase activities (maximum activity 0·9). Asparaginase-resistant lines from these sensitive tumours all had activities of more than 5·8 and two of them were much more active than any of the normal tissues with activities of 34 and 66. Among a group of tumours known to be resistant to asparaginase treatment three had activities within the range for normal mouse tissues, but all the rest had activities much higher than any found in normal tissues, with a maximum of 156.

It is difficult to prepare large quantities of asparaginase in a pure state, but asparaginase from *E. coli* has already been used with some success in the treatment of some human leukaemias (Oettgen *et al.*, *Cancer Res.*, **27**, 2619; 1968). The present work shows that this simple test of asparagine synthetase activity done *in vitro* on preparations of tumour cells should indicate which human tumours will respond to asparaginase treatment. Only tumour cells which are incapable of synthesizing asparagine themselves will be inhibited in their growth by this expensive new agent.

In addition, the very high asparagine synthetase activities found in tumours resistant to asparaginase suggest that tumour cells have a very high requirement for asparagine. Asparagine is known to be used in protein synthesis, but further work on its metabolism in tumour cells may show that tumour cells use their asparagine for other purposes. Asparaginase treatment of cancer depends on a known enzyme deficiency in some tumour cells, but all tumour cells seem to need larger quantities of asparagine than normal cells. Further work on asparagine metabolism might reveal a qualitative difference in metabolism between all tumour cells and normal cells which can be exploited therapeutically.

Report from Rothamsted

THE year 1967 was favourable for the free living nematodes that cause Docking disease—stunting of sugar beet, named after the village in Norfolk where it was first found in 1948. This, however, provided a good opportunity for the nematology department at Rothamsted Experimental Station to continue work on the control of these pests. Large increases in yields were achieved with the well known nematicides, D-D (dichloropropene-dichloropropane) and chloropicrin, applied either to whole fields or to predetermined rows, where the beet was to be sown later. There was also an increase in yield (from 29 to 62 cwt/acre in one experiment and from 48 to 80 cwt/acre in another), when a few ounces/acre of a systemic pesticide were drilled in the furrow with the seed.

As the director, Sir Frederick Bawden, says in the customary thick and comprehensive annual report (price £1), such results indicate that direct chemical attack on these nematodes is a practical proposition. Direct chemical attack seems to be the only way to control losses, because these nematodes feed on the roots of almost any kind of plant, and rotation of crops is no safeguard against them.

One of the hazards of pesticides with which Rothamsted is concerned is the poisoning of bees. Of fifty-three samples received last year thirty-seven contained insecticide; at least twenty were probably killed during the spraying of beans. Bees are usually poisoned if the crops are sprayed while in flower; if spraying was always carried out before flowering, bees should be safe. The bee department at Rothamsted has also been investigating the part played by chemicals in controlling behaviour. When a swarm is in flight, workers are attracted to the queen by the odour of material produced in her head. Two of the substances involved are 9-oxodecenoic and hydroxydecenoic acids, and it has now been shown that it is a mixture of the two odours which attracts workers in flight. In the hive, however, these odours do not attract the workers to the queen. 9-Oxodecenoic acid alone also induces several types of behaviour pattern in bees. In the hive it is important in inhibiting the rearing of queens and the development of workers' ovaries. This acid alone also acts as an aphrodisiac when a drone finds a queen. A pheromone by which worker honeybees recognize the entrances to their hives has now been found, and attempts are being made to isolate and identify this.

Cytoplasmic Organelles

from a Correspondent

ON June 20, the Royal Society held an all-day meeting on the subject of cytoplasmic organelles.